AXIRIS.be

OWS v1.3.2

1-Wire software package

User Manual

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Table of Contents

Revision History

Date	Authors	Description
2013-04-21	Peter S'heeren	Initial release.
2013-04-29	Peter S'heeren	Added section about serial-to-1-Wire adapters. Added software revision history. Added section about program owhbh4.
2013-05-23	Peter S'heeren	Added section about program owsrds. Added section about topology files. Updated numerous sections.
2013-06-08	Peter S'heeren	Added section about 1-Wire support. Updated numerous sections.
2013-06-17	Peter S'heeren	Added section about hubs with program owsrds.
2013-06-27	Peter S'heeren	Added section about program owsmlc. Added section about program owspio.
2013-09-11	Peter S'heeren	Updated various sections.
2014-02-01	Peter S'heeren	Updated various sections.

1 Distribution

The software is available for various systems. Each software package is provided as a compressed archive file.

2 Installation

Linux

Unpack the package in a local directory in your home directory. Be sure you pick the distribution that corresponds with your operating system.

Run the **install.sh** script in the context of your user account to install the software.

Be sure to run the installation script from the command line rather than the file manager. The script will **sudo** and as such the system may ask for the root password.

The installation script will install the programs in directory **/opt/ows**.

Windows

Unpack the package for Win32 in a local directory on your system.

Run the programs in the local directory from the command prompt (cmd.exe).

3 Third-party Software Packages

TMEX is provided by Maxim Integrated:

```
http://www.maximintegrated.com/products/ibutton/software/tmex/
```

The web page of the **LibUSB** project can be found here:

```
http://www.libusb.org/
```

Project **libusbx** is an alternative for the LibUSB project. It serves as a drop-in replacement for the LibUSB library.

```
http://libusbx.org/
```

Project **libwdi** provides a driver installation tool for Windows XP and later called **zadig**. It's advised to download and install this tool when you're planning to use USB-to-1-Wire adapters on Windows. It'll help you to update your USB-to-1-Wire adapters to the drivers that work best for your Windows system.

```
http://sourceforge.net/projects/libwdi/files/zadig/
```

4 1-Wire Support

1-Wire Controllers

- Maxim DS2490 USB-to-1-Wire chip.
- Maxim DS2480/DS2480B serial-to-1-Wire chip.
- Maxim DS2482-100 I2C-to-1Wire chip.
- Maxim DS2482-800 I2C-to-1Wire chip.

1-Wire Adapters

- Axiris AbioWire.
- m.nu 1-Wire Adapter.
- Maxim DS9490R/DS9490B USB-to-1-Wire.
- Maxim DS9097U serial-to-1-Wire.

1-Wire Sensor And Input Devices

- DS1822 thermometer.
- DS18B20 thermometer.
- DS18S20/DS1920 thermometer.
- DS2438 smart battery monitor.
- DS2406/DS2407 dual switch.
- DS2408 8-channel switch.
- DS2423 counter.
- DS2413 dual switch.
- DS2760/DS2761/DS2762 Li+ battery monitor.

1-Wire Control And Output Devices

- Axiris 1-Wire RGB Controller.
- Axiris 1-Wire Mains Switch.
- Hobby Boards 4-channel hub.
- DS2409 MicroLAN coupler.
- DS2406/DS2407 dual switch.
- DS2408 8-channel switch.
- DS2413 dual switch.
- DS2760/DS2761/DS2762 Li+ battery monitor.

1-Wire Bus Speeds

- Regular speed and flexible speed (depending on the 1-Wire controller).

5 Concepts

A 1-Wire **channel** or **bus** is the starting point of a network of 1-Wire slaves that are all connected together.

A 1-Wire **slave** or **device** resides on a 1-Wire bus. It performs a specific task. Each 1-Wire slave carries a unique 64-bit value called the ROM code. This value is world-unique meaning no two 1-Wire slaves in existence carry the same ROM code.

A 1-Wire **hub** is a 1-Wire device that enables you to add branches to the 1-Wire network. A branch is hooked up to a **port** that provides the required electrical characteristics. A hub incorporates one or more ports.

A 1-Wire **controller** is a function that acts as a master of one or more 1-Wire channels (buses). Most controllers provide one channel. The DS2482-800 chip is an example of an 8-channel controller.

Note that a multichannel controller can only work with one channel at a time. A multichannel controller is single-master and as such it can communicate with one 1-Wire slave at any given time. The multichannel feature is there for electrical reasons, not for adding concurrent communication channels with 1-Wire slaves.

A 1-Wire **adapter** represents a logical grouping of one or more 1-Wire controllers. Most adapters have one controller, in which case the terms adapter and controller can be used interchangeably. Some adapters contain multiple controllers. For example, an AbioWire comes with two DS2482-800 controllers and one DS2482-100 controller for a total of seventeen 1-Wire channels.

The concept of adapter enables the software to work with specific 1-Wire adapters. The **ows** programs know certain adapters. The user can specify a known adapter on the command line. The program can display adapter-specific information.

A **task** is part of the program that performs a specific duty on a set of 1-Wire buses. A task is always associated with a controller and is aware of channels. A task may address a single 1-Wire slave or multiple 1-Wire slaves. A task adheres to the selected channel range.

Since a task is associated with a controller, the program creates multiple tasks, one for each controller. These tasks can execute concurrently, greatly improving performance.

6 Usage

The **ows** programs offer a consistent command line interface to the user. All programs share similar functionality like selecting 1-Wire adapters which is reflected in a uniform command line syntax. Besides shared functionality, dedicated arguments allow you to control specific functionality with each program.

Example Commands

This document includes example command invocations on the command prompt of the system's shell. The following notation is used:

```
$ ./owsenum
```

The command is run in a Unix shell as regular user. Note that invocations may need root privileges, so you'll have to put **sudo** in front of the command.

```
# ./owsenum
```

The command is run in a Unix shell as root.

```
> owsenum.exe
```

The command is run from a Windows command prompt. Note that in Windows the extension of the executable file may be omitted.

Command Line Processing

An **ows** program scans the command line in multiple passes. Doing so allows the program to pick up certain arguments from the command line before processing other arguments.

One advantage is that the user isn't required to respect a strict order of arguments. For example, option **-v** can be specified anywhere on the command line; the program will pick it up before any other arguments that produce verbose output, hence verbose output is consistent no matter where option **-v** appears on the command line.

Another advantage is that you can specify option **-h** to print help even when other arguments are ill-formatted.

The **ows** programs work with types of arguments:

- An **option** always starts with a minus character. For example, option **-h** for help.
- A **parameter** never starts with a minus character. A parameter typically follows an option but it may stand alone as well. For example, **-mt 5**, where option **-mt** expects one parameter, being **5** in this example.

If an option is repeated in the command line, the program will react in any of the following ways, depending on the option itself:

- The information of the last option will be retained. For example, **-mt 5 -mt 3** has the same result as **-mt 3**.
- The information of each option will be accumulated in a list. For example, **-lu 1 -lu 2 10** will results in the program scanning USB bus 1 and USB device with address 10 on bus 2.

- The program spawns an error message. For example, program **owswitch** expects either option **-on** or option **-off** to be specified just once.

Representation of Hardware

When an **ows** program prints a 1-Wire slave, it also prints the location of the 1-Wire slave in the hardware topology. The program can print the information in tree format or on a single line. Options **-dst** and **-dsl** control the formatting.

Here's an example dump of a 1-Wire slave in tree format:

```
04: USB to 1-Wire (libusb bus 002 ad 005)
  01: DS2490
    01: 28-0000040CF499-0C  DS18B20 thermometer
```

It says that a DS18B20 1-Wire slave with ROM code 28-0000040CF499-0C is located on the first channel of the first controller of the fourth adapter.

The same information printed in single line formatting is shown as:

```
04:01:01  28-0000040CF499-0C  DS18B20 thermometer
```

Some **ows** programs can work with 1-Wire hubs and as such maintain a tree of 1-Wire slaves, a.k.a. a device tree. These program extend the representation of hardware to include hubs. For example:

```
01: USB to 1-Wire (libusb bus 001 ad 002)
  01: DS2490
    01: 28-0000040CCF80-35  DS18B20 thermometer
    01: 81-000000324BBD-31  DS1420 serial ID button
    01: EF-000015207600-03  Hobby Boards 4-Channel Hub
      02: EF-000015206836-82  Hobby Boards 4-Channel Hub
        02: 28-000003F4B4E9-6A  DS18B20 thermometer
        02: 28-0000040CF499-0C  DS18B20 thermometer
        04: 26-0000016B4948-00  DS2438 smart battery monitor
      02: EF-000015206CCE-4E  Hobby Boards 4-Channel Hub
        04: 28-0000043F84D2-2C  DS18B20 thermometer
```

The same information printed in single line formatting is shown as:

```
01:01:01  28-0000040CCF80-35  DS18B20 thermometer
01:01:01  81-000000324BBD-31  DS1420 serial ID button
01:01:01  EF-000015207600-03  Hobby Boards 4-Channel Hub
01:01:01:02  EF-000015206836-82  Hobby Boards 4-Channel Hub
01:01:01:02:02  28-000003F4B4E9-6A  DS18B20 thermometer
01:01:01:02:02  28-0000040CF499-0C  DS18B20 thermometer
01:01:01:02:04  26-0000016B4948-00  DS2438 smart battery monitor
01:01:01:02  EF-000015206CCE-4E  Hobby Boards 4-Channel Hub
01:01:01:02:04  28-0000043F84D2-2C  DS18B20 thermometer
```

The values at the fourth and next positions represent the hub port number. The hub itself is shown in the preceding line.

The **ows** programs represent a location in the hardware using a specific notation:

adapter:controller:channel[:port]

Each field is a two-digit decimal value starting from one.

The first three values are in fact indexes that refer to the nodes in the topology of the selected 1-Wire adapters. You can specify option **-da** to print the topology and the index values of the various nodes.

Values starting at the fourth position are hub port numbers.

Selecting 1-Wire Adapters

Your system may be connected to many 1-Wire adapters of various kinds. You'll have to specify which 1-Wire adapters will be used when running an **ows** program.

The **ows** programs offer a uniform command line syntax for specifying 1-Wire adapters. Command line options allow you to specify 1-Wire adapters for specific software interfaces, like LibUSB or TMEX.

Specify option **-da** to print the list of 1-Wire adapters that the program will use.

Once the program has established a list of 1-Wire adapters, it creates tasks for the various controllers that are part of the adapters. The selected channel range may narrow the creation of the tasks. For example, if you limit the channel range to 5..8, only controllers that actually have these channels will be assigned a task.

LibUSB

LibUSB provides a platform-independent API for accessing USB devices on various operating systems.

The **ows** programs scan for the following USB identifiers:

VID	PID	REL	Device
04FAh	2490h	any	Maxim DS2490 USB-to-1-Wire chip.[1]

[1] 1-Wire adapters DS9490R and DS9490B incorporate this chip.

The following command line arguments control the use of LibUSB:

Option	Description
-lu	Scan all USB devices on all buses.
-lu b	Scan all USB devices on bus b (1..255 decimal).
-lu b ad	Scan USB device with address ad (1..127 decimal) on bus b (1..255 decimal).
-ludbg n	Set the debug level for LibUSB. Value n=0..3 decimal. The default value is zero.

You've to specify at least one **-lu** option to tell the program to use LibUSB. The **-lu** options are added to a list. The program requests a list of all USB devices with LibUSB and scans for matching VID/PID/REL values (see table above) while restricting the search range according to the list.

I2C

Pointing to an I2C-to-1-Wire adapter is a two-step process. First you specify the I2C master. Next you add one or more I2C-to-1-Wire adapters for the specified I2C master. Note that an I2C master represents a I2C bus that can connect multiple I2C-to-1-Wire functions.

The following table summarizes all I2C masters known to the **ows** software. The availability of each I2C master depends on the architecture of your system:

Option	Description
-i2cdev path	Add the i2c-dev path of an I2C master.
-bsc n	Add BSC n (0,1) of a BCM2835 application processor.
-bscdetect	Detect the I2C bus that's present on the GPIO connector of a BCM2835-based computer.

Following the I2C option, you can add any number of the following parameters to specify I2C-to-1-Wire adapters:

Parameters	Description
ds2482 ad	Add a 1-Wire master DS2482 chip at the given I2C address.
abiowire	Add an AbioWire adapter. This adapter incorporates three 1-Wire controllers: ▪ DS2482-800 at address 24. ▪ DS2482-800 at address 25. ▪ DS2482-100 at address 26.
mnu[n]	Add an m.nu 1-Wire adapter. Parameter n is optional (0..3). This adapter incorporates a DS2482-100.

If you specify overlapping I2C devices (devices with the same address) then the program will display an error message and quit.

Parameters **mnu** and **mnu0** are equal and refer to the m.nu adapter configured for I2C address 27. This address is in effect when the solder jumpers AD0 and AD1 are open. Parameters **mnu1**, **mnu2** and **mnu3** correspond with I2C address 26, 25, and 24 resp.

Example

Suppose two DS2482 chips are wired to an I2C master that's accessible through i2c-dev path /dev/i2c-0:

```
# ./owsenum -i2cdev /dev/i2c-0 ds2482 24 ds2482 25
```

Both chips will be used for enumeration.

TMEX

The TMEX software is provided by Maxim Integrated and runs on Windows.

Option	Description
-tm t n	Add 1-Wire adapter with port type t (0..15) and port number n (0..15).

You've to specify at least one **-tm** option to tell the program to use TMEX. The **-tm** options are added to a list.

The port type corresponds with a hardware interface like USB, the port number distinguishes between multiple adapters of the same port type. The assignment of port numbers depends on the port type and is fully controlled by TMEX. For example, **-tm 6 1** indicates the USB-to-1-Wire adapter that was plugged in first.

By default these port types are defined:

Port Type	Description
1	DS9097E adapter on serial port.
2	DS1410E adapter on parallel port.
5	DS9097U adapter on serial port.
6	DS9490 adapter on USB.

TMEX is slow. It's advised to use TMEX only for 1-Wire adapters that the **ows** software doesn't support, like the DS1410E adapter with parallel port interface.

Serial

To use a serial-to-1-Wire adapter, first you've to specify the serial port, then the adapter that connects to the serial port. The serial port is identified by a so-called serial path. Both Linux and Windows support serial paths.

Option	Description
-serial path	Add the path of a serial port.

Following the serial path, you've to specify a serial-to-1-Wire adapter:

Parameters	Description
ds9097u	DS9097U adapter. This adapter has an embedded DS2480B 1-Wire controller chip. The DTR and RTS lines are wired as a power source for the chip.
ds2480	DS2480 or DS280B chip.

If you specify **ds9097u**, the program will set and clear DTR to control the power to the adapter.

Parameter **ds2480** implies a DS2480 or DS280B chip is connected to the serial port using the TX and RX lines only.

Example

```
# ./owsenum -serial /dev/ttyS0 ds9097u
```

This command enumerates all 1-Wire slaves that are connected to the DS9097U adapter on the first UART.

```
> owsenum.exe -serial \\.\COM1 ds9097u
```

This command enumerates all 1-Wire slaves that are connected to the DS9097U adapter on the first UART. You're advised to use the NT namespace prefix **\\.**. See section Serial Paths more information.

Use of USB-to-serial adapters

You can use a USB-to-serial adapter to hook up a serial-to-1-Wire adapter to your computer.

For example, suppose a DS9097U is connected to a USB-to-serial adapter that resides on serial path **/dev/ttyUSB0**. The following command will enumerate all 1-Wire slaves that are connected to the DS9097U adapter.

```
# ./owsenum -serial /dev/ttyUSB0 ds9097u
```

Note that using a USB-to-serial adapter is slower than using an on-board serial port.

Selecting a Range of Channels

When you're controlling one specific 1-Wire slave device, it's advisable to narrow down the specification of 1-Wire adapters to one specific channel in your physical 1-Wire topology.

Option	Description
-ch n	Limit all 1-Wire adapters to channel n. Value n=1..8 decimal.
-ch n m	Limit all 1-Wire adapters to channels n to m. Values n,m=1..8 decimal.

The default channel range is 1 to 8.

Example

Suppose you're working with a 1-Wire RGB controller with ROM code 29-00000011CEE1-0A. The 1-Wire device is connected to channel 5 of the second 1-Wire controller of an AbioWire adapter. The AbioWire is plugged onto a Raspberry Pi.

```
# ./owrgbctrl -bscdetect ds2482 25 -ch 5 -id 29-11CEE1 -bo 50 -ro 20 -go 5
```

If successful, this command will put the RGB controller's output channels to (50;20;5).

Maximal Number of Concurrent Tasks

Normally when you run an **ows** program, it will execute all tasks concurrently to improve performance. You can change this behavior on the command line.

Option	Description
-mt n	Set the maximal number of concurrent tasks to n (0, 1..255). Value zero means unlimited, thus all tasks will be run concurrently. The default value is zero.

Obviously the program will perform best when **-mt** is set to zero.

Option **-mt** provides useful features:

- Troubleshooting a situation in Linux on a BCM2835-based computer where LibUSB reports error 4008.
- Improved deterministic behavior. If you're noticing non-deterministic behavior with multiple concurrent tasks and you prefer to avoid this, you can specify **-mt 1** to confine the execution of tasks to one-by-one. For example, if you run **owsenum** in verbose mode using multiple 1-Wire adapters, you may see a different enumeration order of 1-Wire slaves each time you run the program. If you prefer the same order each time you run the program, add **-mt 1**.

Dumping Information

The programs offer a set of options for controlling the way information is written to standard output.

Option	Description
-h	Dump help and exit the program.
-v	Verbose mode.
-da	Dump all 1-Wire adapters in detailed tree format before executing the main tasks of the program.
-dsl	Output information about a 1-Wire slave on a single line.
-dst	Output information about a 1-Wire slave in tree format. The 1-Wire slave is displayed as part of an adapter. This setting is the default.

Verbose mode **-v** is useful for troubleshooting, for example, if you want to see which 1-Wire adapters are taken into account.

Arguments **-dsl** and **-dst** are opposites.

7 Program owsenum

This program is an enumeration tool. It enumerates 1-Wire slaves that are connected to the selected 1-Wire adapters.

Command Line

Besides the common options, the program offers the following options:

Option	Description
-hub	Enumerate all 1-Wire slaves hierarchically throughout hubs.
-alarm	Enumerate 1-Wire slaves with the alarm flag set.
-family x	Enumerate 1-Wire slaves with family code x (00..FF, hexadecimal).
-topo f	Write the enumeration results to topology file f using the default encoding.
-topo f enc	Write the enumeration results to topology file f using encoding enc. The encoding field can be one of the following: **utf8**, **utf16le**, **utf16be**.

If option **-hub** is specified, the program will enumerate all 1-Wire slaves hierarchically throughout hubs. If the option is not specified, the program will enumerate the 1-Wire slaves as they appear on the bus depending on the current state of each hub.

Note that the program will alter the state of the hub ports if option **-hub** is specified. If this is not your intention, don't use the option.

Option **-alarm** tells the program to use the Alarm Search (ECh) command rather than the Search ROM (F0h) command for enumeration.

You can confine the enumeration of 1-Wire slaves to a specific device family with option **-family**.

If **-topo** is specified, the program will write a topology file that contains a description of all enumerated 1-Wire networks. The topology file is a Unicode text file. The default encoding depends on the target system. You can specify an encoding to overrule the default one.

A topology file generated by program **owsenum** is typically fed to program **owsrds**.

Hubs

The program supports the following 1-Wire hubs:

- Hobby Boards 4-Channel Hub.
- Maxim DS2409 MicroLAN coupler. This chip is used in various hubs:
  - Hobby Boards 6-channel hub (contains three DS2409 chips).

Hobby Boards 4-Channel Hub

This hub has four ports. Each port can be independently turned on or off. The hub can act as a power injector.

The family code of the hub is **EFh**. The device type within this family is **05h**.

DS2409

The DS2409 chip provides two ports called MAIN and AUX. The **ows** software designates MAIN as port 1 and AUX as port 2.

Devices like the Hobby Boards 6-channel hub incorporate multiple DS2409 chips that are connected in parallel to the same 1-Wire bus. Although such hubs may number the MAIN and AUX ports in ascending order on the PCB or the case, software has no means to determine this numbering. Instead software will assume the order produced by the enumeration algorithms and ultimately the ROM codes of the various DS2409 chips will determine this order.

For example, when program **owsenum** is enumerating a 6-channel hub from Hobby Boards, the status LEDs may turn on and off in an unexpected sequence.

The DS2409 chip offers command for speeding up the enumeration process. The program takes advantage of these commands.

The family code of the DS2409 is **1Fh**.

Program Exit Status

If the program executed successfully, it returns zero, else it returns -1.

Example Invocations of the Program

```
# ./owsenum -lu
```

This command will enumerate the 1-Wire slaves found on all USB-to-1-Wire adapters.

```
# ./owsenum -lu -hub
```

This command will enumerate 1-Wire slaves hierarchically throughout hubs found on all USB-to-1-Wire adapters.

```
# ./owsenum -i2cdev /dev/i2c-1 ds2482 24 -ch 5 8
```

This command will enumerate the 1-Wire slaves found on channels 5 to 8 of the DS2482-800 chip at I2C address 24 on I2C bus /dev/i2c-1.

```
# ./owsenum -lu -family 28
```

This command will enumerate members of the DS18B20 family. Note that **28** is an hexadecimal value.

```
# ./owsenum -bscdetect abiowire -hub -topo mynetworks.txt
```

This command will enumerate all controllers and channels on an AbioWire and write the resulting information to a topology file named **mynetworks.txt**.

8 Program owsprobe

With this program you can locate a specific 1-Wire slave device on the selected 1-Wire adapters.

Command Line

Besides the common options, the program offers the following options:

Option	Description
-id n	Identifier of the 1-Wire slave. Field n is formatted in either of the following ways: ▪ xx-xxxxxxxxxxxx: Family code, serial. The CRC will be calculated. ▪ xx-xxxxxxxxxxxx-xx: Family code, serial, CRC. You specify a full ROM code. All x are hexadecimal digits. Leading zeroes can be omitted.

Program Exit Status

If the program executed successfully, it returns zero, else it returns -1.

Example Invocations of the Program

```
# ./owsprobe -lu -id 29-11CEE1
```

This command searches for the given 1-Wire slave identifier on all available USB-to-1-Wire adapters.

9 Program owrgbctrl

This program controls the Axiris 1-Wire RGB Controller device.

Command Line

Besides the common options, the program offers the following options:

Option	Description
-id n	Identifier of the 1-Wire slave. Field n is formatted in either of the following ways: ▪ xx-xxxxxxxxxxxx: Family code, serial. The CRC will be calculated. ▪ xx-xxxxxxxxxxxx-xx: Family code, serial, CRC. You specify a full ROM code. All x are hexadecimal digits. Leading zeroes can be omitted.
-pr	Probe the ROM code first.
-c	Clear all registers.
-ro n	Enable the red channel and set the ON period to n (0..255).
-go n	Enable the green channel and set the ON period to n (0..255).
-bo n	Enable the blue channel and set the ON period to n (0..255).
-re	Enable the red channel.
-ge	Enable the green channel.
-be	Enable the blue channel.
-rd	Disable the red channel.
-gd	Disable the green channel.
-bd	Disable the blue channel.

The program's main task is to sends a bundle of commands to the RGB controller. The various arguments determine which commands will be send. Use **-v** to print the commands to standard output.

If **-pr** is specified, the program will first probe the ROM code on the selected 1-Wire adapters. If probed successfully, the program knows the location of the 1-Wire RGB Controller and the program will execute its main task for that location.

If **-pr** is not specified, the program will execute its main task for all controllers of the selected 1-Wire adapters.

Specify **-v** to see the actual command bytes that are written to the RGB controller.

Program Exit Status

If the program executed successfully, it returns zero, else it returns -1.

Example Invocations of the Program

```
> owrgbctrl.exe -lu -id 29-11CEE1 -c
```

This command clears all internal registers of the target 1-Wire RGB controller.

```
> owrgbctrl.exe -lu -id 29-11CEE1 -ro 50 -go 20 -bo 80
```

This command clears sets the internal RGB registers of the target 1-Wire RGB controller to (50;20;80).

10 Program owswitch

This program controls the Axiris 1-Wire Mains Switch device.

Command Line

Besides the common options, the program offers the following options:

Option	Description
-id n	Identifier of the 1-Wire slave. Field n is formatted in either of the following ways: ▪ xx-xxxxxxxxxxxx: Family code, serial. The CRC will be calculated. ▪ xx-xxxxxxxxxxxx-xx: Family code, serial, CRC. You specify a full ROM code. All x are hexadecimal digits. Leading zeroes can be omitted.
-pr	Probe the ROM code first.
-on	Turn the mains switch on.
-off	Turn the mains switch off.

The program's main task is to turn on or turn off the switch.

If **-pr** is specified, the program will first probe the ROM code on the selected 1-Wire adapters. If probed successfully, the program knows the location of the 1-Wire Mains Switch and the program will execute its main task for that location.

If **-pr** is not specified, the program will execute its main task for all controllers of the selected 1-Wire adapters.

Program Exit Status

If the program executed successfully, it returns zero, else it returns -1.

Example Invocations of the Program

```
# ./owswitch -i2cdev /dev/i2c-0 ds2482 24 -ch 7 -id 12-A220A8 -on
```

This command turns on the switch. The device is supposed to be connected to channel 7 of the DS2482-800 chip.

```
> owswitch.exe -lu -pr -id 12-A220A8 -off
```

This command probes the 1-Wire Mains Switch on all USB-to-1-Wire adapters. If found, the program turns off the switch.

11 Program owhbh4

This program controls the Hobby Boards 4-Channel Hub.

Command Line

Besides the common options, the program offers the following options:

Option	Description
-id n	Identifier of the 1-Wire slave. Field n is formatted in either of the following ways: ▪ xx-xxxxxxxxxxxx: Family code, serial. The CRC will be calculated. ▪ xx-xxxxxxxxxxxx-xx: Family code, serial, CRC. You specify a full ROM code. All x are hexadecimal digits. Leading zeroes can be omitted.
-pr	Probe the ROM code first.
-setcfg mode	Set the channel mode. Field mode can be one of the following: ▪ **m**: Select multichannel mode. ▪ **s**: Select single-channel mode.
-setch on|**off** [**1**|**2**|**3**|**4**]	Turn on or off any of the given channels. You've to specify either on or off followed by one or more channel values.
-info	Query information.

The program's main task is to configure the hub, to activate and deactivate the hub's channels, and to query information.

The Hobby Board devices allocate family code EF (hexadecimal) and provide a command to read the type of device. The program will always check the type and make sure the device is a 4-channel hub.

If **-pr** is specified, the program will first probe the ROM code on the selected 1-Wire adapters. If probed successfully, the program knows the location of the 1-Wire slave and the program will execute its main task for that location.

If **-pr** is not specified, the program will execute its main task for all controllers of the selected 1-Wire adapters.

When multiple of the following commands are specified, they're executed in this order:

-setcfg ► -setch ► -info

Program Exit Status

If the program executed successfully, it returns zero, else it returns -1.

Example Invocations of the Program

```
# ./owhbh4 -lu 001 010 -id EF-15207BA3 -info
```

This command dumps all accessible information of the hub connected to the USB-to-1-Wire adapter with USB address 10 sitting on bus 1.

```
# ./owhbh4 -v -pr -lu -id EF-15207BA3 -info -setch on 2 4 -setcfg m
```

This command does the following work:

1. It looks for (probes) the 4-channel hub with the given ROM code on all detected USB-to-1-Wire adapters. If not found, the program stops.
2. It set the hub's configuration to multichannel mode.
3. It turns on channels 2 and 4.
4. It dumps all accessible information.

12 Program owsmlc

This program controls the Maxim DS2409 MicroLAN Coupler.

Command Line

Besides the common options, the program offers the following options:

Option	Description
-id n	Identifier of the 1-Wire slave. Field n is formatted in either of the following ways: ▪ xx-xxxxxxxxxxxx: Family code, serial. The CRC will be calculated. ▪ xx-xxxxxxxxxxxx-xx: Family code, serial, CRC. You specify a full ROM code. All x are hexadecimal digits. Leading zeroes can be omitted.
-pr	Probe the ROM code first.
-st	Read status. This is the default action. It can also be combined with one of the control commands to read status back after a control command has completed.
-disch	Discharge.
-dmain	Direct-on main channel.
-main	Smart-on main channel.
-aux	Smart-on auxiliary channel.
-off	Turn off the active channel.
-cout main	Associate the control output with the main channel.
-cout aux	Associate the control output with the auxiliary channel.
-cout on	Turn on the control output.
-cout off	Turn off the control output.

The program's main task is to activate and deactivate the main channel and the auxiliary channel, to manipulate the control output pin, and to read the status.

If **-pr** is specified, the program will first probe the ROM code on the selected 1-Wire adapters. If probed successfully, the program knows the location of the 1-Wire slave and the program will execute its main task for that location.

If **-pr** is not specified, the program will execute its main task for all controllers of the selected 1-Wire adapters.

Options **-disch**, **-dmain**, **-main**, **-aux**, **-off**, and **-cout** each start a control command. You can start one control command. If you combine a control command with option **-st** then the program will read the status after the control command has completed.

If neither a control command or the read status command is specified, the program will simply read and print the status of the coupler.

NOTE

If you use the program to read status only and you don't specify option **-pr**, then the program will always output the status even if the MicroLAN coupler isn't present on the 1-Wire bus. If the device is not present, all status flags will be logic one.

The reason is the DS2409 chip doesn't provide a way to check the validity of the outcome of the read status command in case the device isn't present on the 1-Wire bus. In a situation where you're working with multiple adapters and/or multiple channels, you'll see a status report for each channel.

Program Exit Status

If the program executed successfully, it returns zero, else it returns -1.

Example Invocations of the Program

```
# ./owsmlc -lu -id 1F-871FE
```

This command reads the status from the the MicroLAN coupler and prints the information.

```
# ./owsmlc -v -pr -lu -id 1F-871FE -main
```

This command looks for (probes) the MicroLAN coupler with the given ROM code on all detected USB-to-1-Wire adapters. If found, the program activates the main channel.

```
# ./owsmlc -v -pr -lu -id 1F-871FE -st
```

This command does the same as the previous command with the addition the that it reads and prints the status after the main channel has been activated.

13 Program owspio

This programs allows you to work with the programmable I/O channels (PIO) of 1-Wire devices. You can sense the state, set the output level, and monitor the activity flag of PIO channels (pins).

Command Line

Besides the common options, the program offers the following options:

Option	Description
-id n	Identifier of the 1-Wire slave. Field n is formatted in either of the following ways: ▪ xx-xxxxxxxxxxxx: Family code, serial. The CRC will be calculated. ▪ xx-xxxxxxxxxxxx-xx: Family code, serial, CRC. You specify a full ROM code. All x are hexadecimal digits. Leading zeroes can be omitted.
-pr	Probe the ROM code first.
-off [**1**|…|**8**]	Turn off the specified channels.
-on [**1**|…|**8**]	Turn on the specified channels.
-read	Read the PIO channels once. This is the default behavior.
-read n	Read the PIO channels n times. 0 means infinite times, 1.. means finite times, default value is 1.
-read n ms	Read the PIO channels n times with ms interval. 0 means infinite times, 1.. means finite times, default value is 0. The interval is specified in milliseconds, value 1..3600000, default value is 1000.
-rstz s|r	DS2408: Configure the RSTZ pin as $\overline{\text{STRB}}$ output (**s**) or $\overline{\text{RST}}$ input (**r**).

The program's main task is to turn on and off the specified PIO channels and read back once or periodically the state of a chip's PIO channels.

If **-pr** is specified, the program will first probe the ROM code on the selected 1-Wire adapters. If probed successfully, the program knows the location of the 1-Wire slave and the program will execute its main task for that location.

If **-pr** is not specified, the program will execute its main task for all controllers of the selected 1-Wire adapters.

Option **-off** specifies the PIO channels to be turned off (logic zero). Option **-on** specifies the PIO channels to be turned on (logic one). If a channel is specified in both **-on** and **-off** options then the **-on** option takes precedence and the channel will be turned on.

Option **-read** tells the program to read back the state of the chip's PIO channels. The outcome depends on the type of 1-Wire slave you've specified in option **-id**.

Option **-read** takes two optional parameters. The first parameter is the number of times to read. The second parameter is the interval in milliseconds in-between two read operations.

Option **-rstz** is specific to the DS2408 chip. It enables you to configure the RSTZ pin as $\overline{\text{STRB}}$ output or $\overline{\text{RST}}$ input.

If option **-rstz** is combined with option **-on** and/or option **-off**, the program will first configure the RSTZ pin.

1-Wire Devices

The program supports the following 1-Wire devices with PIO:

1-Wire Device	Family Code	PIO Channels
DS2406/2407 1Kb EPROM dual switch	12h	1 or 2
DS2408 8-channel addressable switch	29h	8
DS2760/DS2761/DS2762 Li+ battery monitor	30h	1
DS2413 dual-channel addressable switch	3Ah	2

Program Exit Status

If the program executed successfully, it returns zero, else it returns -1.

Example Invocations of the Program

```
# ./owspio -lu -id 29-11CEE1
```

This command reads the state of the PIO channels from the DS2408 chip.

```
# ./owspio -lu -id 29-11CEE1 -on 4 6 -off 2 7 -rstz s
```

This command first configures the RSTZ pin of the DS2408, then it sets the state of the PIO channels according to the **-on** and **-off** options.

14 Program owsrds

This program reads 1-Wire sensor devices.

Command Line

Besides the common options, the program offers the following options:

Option	Description
-network [n]	Add a network directly from the command line. You can specify a branch of 1-Wire slaves but not a tree hierarchy using hubs this way. Use a topology file to reach the latter goal. Field n is formatted in either of the following ways: ▪ xx-xxxxxxxxxxxx: Family code, serial. The CRC will be calculated. ▪ xx-xxxxxxxxxxxx-xx: Family code, serial, CRC. You specify a full ROM code. All x are hexadecimal digits. Leading zeroes can be omitted. If you opt to specify a CRC and it's wrong, the program reports an error and quits.
-topo f	Read the topology file f and add the resulting networks.
-nid n	Detect up to n non-identification chip devices per network. Value n=1..255 decimal. The default value is 1.
-tc	Show temperatures in Celsius. This is the default setting.
-tf	Show temperatures in Fahrenheit.
-tk	Show temperatures in Kelvin.

The program's main task is twofold:

1. To associate a set of 1-Wire networks with the specified 1-Wire adapters.
2. To read all 1-Wire sensor devices.

Both options **-network** and **-topo** can be specified multiple times. You use these options to build a list of networks.

A network is not associated with a physical 1-Wire bus. Instead your task is to provide a set of networks and let program **owsrds** discover the physical location of each network.

Before the program starts discovering the various networks, it sorts the devices in the top-level branch of each network. Identification chips are moved to the beginning of the branch followed by all other 1-Wire slave devices. The resulting devices in the top-level branch will be ordered as follows:

1. 1-Wire slaves with family code 01h. These identification chips are typically used to tag a network.
2. 1-Wire slaves with family code 81h. These identification chips occur in 1-Wire adapters like the DS9490R.
3. All other 1-Wire slaves.

In order to discover a network, the program probes the devices in the top-level branch of a network on the available 1-Wire buses. Devices behind hubs are not eligible for the discovery procedure.

The devices are probed in the order they were sorted. As soon as one device is detected, the network is deemed discovered.

All identification chip devices are used for probing. If none is detected, the program probes a number of non-identification chip devices as specified by option **-nid**. So, if a network can't be discovered based on its identification chip device(s), it may still be discovered based on one of the other devices like a sensor or a hub, providing that **-nid** is non-zero.

If option **-nid** is set to zero, the program will only use identification chip devices during the discovery procedure.

When a network is detected on a 1-Wire bus, the bus will be excluded from further detection of other, undiscovered networks. Hence there's a one-to-one relation between a 1-Wire bus and a network.

After a network has been discovered, the corresponding task will start the sense procedure. This step involves reading all known sensor devices that are part of the network.

Specify option **-v** to see the various steps the program is executing. The verbose output of this program is rather elaborate.

Program behavior with respect to 1-Wire hubs:

- During the discovery procedure, the program doesn't access any hubs. This means at this point in the execution of the program if any hub ports are active the program will consider the visible subbranches on 1-Wire bus as the top-level branch.
- During the sense procedure, the program activates and deactivates hub ports whilst iterating the device tree. The program however doesn't initialize any hubs or hub ports to any state before iterating the device tree. This behavior is contrary to the behavior of program **owsenum** which will execute a fully deterministic run over the available hubs by first deactivating all ports before activating the first port.

Program Output

The program outputs a stream of bytes that encode 7-bit ASCII characters (subset of UTF-8 encoding). This document represents the characters as Unicode.

The program outputs sense data in a consistent manner. Even with option **-v** enabled, the sense data can be indiscriminately filtered from the verbose output. Here's an example output from program **owsrds**:

```
[DS18B20   ] 28-000003F4B4E9-6A 2014-02-01 18:15:09 01BC +027.8 C parasite
[DS18B20   ] 28-0000040CF499-0C 2014-02-01 18:15:10 01BF +027.9 C parasite
[DS2438    ] 26-0000016B4948-00 2014-02-01 18:15:11 0344 +026.1 C 00D9 02.17 V 01FE 05.10 V
[DS18S20   ] 10-000802A49A17-B1 2014-02-01 18:15:12 0035 +026.5 C external
[DS18B20   ] 28-0000043F84D2-2C 2014-02-01 18:15:13 01AB +026.7 C parasite
[DS2406    ] 12-000000974696-90 2014-02-01 18:15:13 0 0 1 1 1 1 2 parasite
[DS2423    ] 1D-0000000DAC01-7B 2014-02-01 18:15:13 0000000061 0000000020
[DS18B20   ] 28-0000040CF2DE-60 2014-02-01 18:15:14 01AF +026.9 C parasite
[DS1822    ] 22-0000003201DA-1C 2014-02-01 18:15:15 01BF +027.9 C parasite
[DS2413    ] 3A-000000052F6A-85 2014-02-01 18:15:15 0 0 1 1
```

You can feed the sense data to another process that parses the information. The formatting is such that the sense data can be parsed without the need for a tokenizer.

The lines with sense data start with a **[** character. Software can scan for this character as a unique identifier for a line with sense data outputted by program **owsrds**.

Each line of sense data starts with a common part:

Offset	Length	Description
+00	1	Left square bracket character (U+005B).
+01	10	Identification of the 1-Wire slave. Padded with space characters (U+0020) if needed.
+11	1	Right square bracket character (U+005D).
+12	1	A space character (U+0020).
+13	2	*ROM code*: Family code (00..FF, hexadecimal).
+15	1	*ROM code*: A hyphen (minus) character (U+002D).
+16	12	*ROM code*: The serial number (12 digits, hexadecimal).
+28	1	*ROM code*: A hyphen character (U+002D).
+29	2	*ROM code*: CRC value (00..FF, hexadecimal).
+31	1	A space character (U+0020).
+32	4	*Date*: Year (4 digits, decimal).
+36	1	*Date*: A hyphen (minus) character (U+002D).
+37	2	*Date*: Month (01..12, decimal).
+39	1	*Date*: A hyphen (minus) character (U+002D).
+40	2	*Date*: Day (01..31, decimal).
+42	1	A space character (U+0020).
+43	2	*Time*: Hour (00..23, decimal).
+45	1	*Time*: A colon character (U+003A).
+46	2	*Time*: Minute (00..59, decimal).
+48	1	*Time*: A colon character (U+003A).
+49	2	*Time*: Second (00..59, decimal).
+51	1	A space character (U+0020).

The formatting of the remainder of the line is subject to the type of 1-Wire slave.

Temperature Sensors

```
[DS18B20    ] 28-0000040CF2DE-60 2014-02-01 18:15:14 01AF +026.9 C parasite
```

If a bus error occurs an invalid temperature register value may have been transferred:

```
[DS18B20    ] 28-0000040CF499-0C 2014-02-01 20:18:28 8052 -------- parasite
```

The gray text is the common part of the line of sense data.

Identification		DS18S20 DS1822 DS18B20
Offset	**Length**	**Description**
+52	4	*Temperature:* Register value (4 digits, hexadecimal).
+56	1	*Temperature:* A space character (U+0020).
+57	8	*Temperature:* The register value is valid:
+57	1	*Temperature:* Plus sign (U+002B) or minus sign (U+002D).
+58	3	*Temperature:* Mantissa (3 digits, decimal).
+61	1	*Temperature:* Decimal point (U+002E).
+62	1	*Temperature:* Fraction (1 digit, decimal).
+63	1	*Temperature:* A space character (U+0020).
+64	1	*Temperature:* ▪ 'C' for Celsius (U+0043). ▪ 'F' for Fahrenheit (U+0046). ▪ 'K' for Kelvin (U+004B).
+57	8	*Temperature:* The register value is invalid:
+57	8	*Temperature:* Line of hyphen characters (U+002D).
+65	1	A space character (U+0020).
+66	8	Power mode. One of the following: ▪ **external** ▪ **parasite**

The register value is deemed valid when it's representation in the selected temperature scale fits in the output format. In a nutshell, if the absolute temperature value is 999.9 or less it's considered valid, else the program considers it invalid and outputs a dashed line made up of hyphen characters.

Maxim DS2438

```
[DS2438     ] 26-0000016B4948-00 2014-02-01 18:15:11 0344 +026.1 C 00D9 02.17 V 01FE
05.10 V
```

If a bus error occurs one or both voltage register values may be invalid. The temperature register value is always valid.

```
[DS2438     ] 26-0000016B4948-00 2014-02-01 18:15:11 0344 +026.1 C 00D9 ------- 01FE
-------
```

The gray text is the common part of the line of sense data.

Identification		DS2438
Offset	**Length**	**Description**
+52	4	*Temperature:* Register value (4 digits, hexadecimal).
+56	1	*Temperature:* A space character (U+0020).
+57	1	*Temperature:* Plus sign (U+002B) or minus sign (U+002D).
+58	3	*Temperature:* Mantissa (3 digits, decimal).
+61	1	*Temperature:* Decimal point (U+002E).
+62	1	*Temperature:* Fraction (1 digit, decimal).
+63	1	*Temperature:* A space character (U+0020).
+64	1	*Temperature:* ▪ 'C' for Celsius (U+0043). ▪ 'F' for Fahrenheit (U+0046). ▪ 'K' for Kelvin (U+004B).
+65	1	A space character (U+0020).
+66	4	*VAD:* Register value (4 digits, hexadecimal).
+70	1	*VAD:* A space character (U+0020).
+71	7	*VAD:* The register value is valid:
+71	2	*VAD:* Mantissa (2 digits, decimal).
+73	1	*VAD:* Decimal point (U+002E).
+74	2	*VAD:* Fraction (2 digits, decimal).
+76	1	*VAD:* A space character (U+0020).
+77	1	*VAD:* 'V' for Voltage (U+0043).
+71	7	*VAD:* The register value is invalid:
+71	7	*VAD:* Line of hyphen characters (U+002D).
+78	1	A space character (U+0020).
+79	4	*VDD:* Register value (4 digits, hexadecimal).
+83	1	*VDD:* A space character (U+0020).
+84	7	*VDD:* The register value is valid:
+84	2	*VDD:* Mantissa (2 digits, decimal).

+86	1	*VDD:* Decimal point (U+002E).
+87	2	*VDD:* Fraction (2 digits, decimal).
+89	1	*VDD:* A space character (U+0020).
+90	1	*VDD:* 'V' for Voltage (U+0043).
+84	7	*VDD:* The register value is invalid:
+84	7	*VDD:* Line of hyphen characters (U+002D).

Maxim DS2406

```
[DS2406    ] 12-000000974696-90 2014-02-01 18:15:13 0 0 1 1 1 1 2 parasite
```

The gray text is the common part of the line of sense data.

Identification	`DS2406`	
Offset	**Length**	**Description**
+52	1	*PIO-A sensed state:* 0 or 1 (binary digit).
+53	1	A space character (U+0020).
+54	1	*PIO-B sensed state:* ▪ PIO-B is present: 0 or 1 (binary digit). ▪ PIO-B is not present: hyphen character (U+002D).
+55	1	A space character (U+0020).
+56	1	*PIO-A output state:* 0 or 1 (binary digit).
+57	1	A space character (U+0020).
+58	1	*PIO-B output state:* ▪ PIO-B is present: 0 or 1 (binary digit). ▪ PIO-B is not present: hyphen character (U+002D).
+59	1	A space character (U+0020).
+60	1	*PIO-A activity state:* 0 or 1 (binary digit).
+61	1	A space character (U+0020).
+62	1	*PIO-B activity state:* ▪ PIO-B is present: 0 or 1 (binary digit). ▪ PIO-B is not present: hyphen character (U+002D).
+63	1	A space character (U+0020).
+64	1	*PIO pin count:* 1 or 2 (decimal digit). PIO-B is present if this value is set to 2. PIO-A is always present.
+65	1	A space character (U+0020).
+66	8	Power mode. One of the following: ▪ **`external`** ▪ **`parasite`**

Maxim DS2408

```
[DS2408      ] 29-00000011CEE1-0A 2014-02-01 18:15:10 00000000 00010110 00000000
reset external
```

The gray text is the common part of the line of sense data.

Identification	DS2408	
Offset	**Length**	**Description**
+52	8	*PIO sensed state:* Register value (8 digits, binary).
+60	1	A space character (U+0020).
+61	8	*PIO output state:* Register value (8 digits, binary).
+69	1	A space character (U+0020).
+70	8	*PIO activity state:* Register value (8 digits, binary).
+78	1	A space character (U+0020).
+79	6	Configuration of the RSTZ pin. One of the following: ▪ `reset` ▪ `strobe`
+85	1	A space character (U+0020).
+86	8	Power mode. One of the following: ▪ `external` ▪ `parasite`

Maxim DS2413

```
[DS2413    ] 3A-000000052F6A-85 2014-02-01 18:15:15 0 0 1 1
```

The gray text is the common part of the line of sense data.

Identification	DS2413	
Offset	**Length**	**Description**
+52	1	*PIO-A sensed state:* 0 or 1 (binary digit).
+53	1	A space character (U+0020).
+54	1	*PIO-B sensed state:* 0 or 1 (binary digit).
+55	1	A space character (U+0020).
+56	1	*PIO-A output state:* 0 or 1 (binary digit).
+57	1	A space character (U+0020).
+58	1	*PIO-B output state:* 0 or 1 (binary digit).

Maxim DS2423

```
[DS2423    ] 1D-0000000DAC01-7B 2014-02-01 18:15:13 0000000061 0000000020
```

The gray text is the common part of the line of sense data.

Identification		DS2423
Offset	**Length**	**Description**
+52	10	*Counter A:* Register value (10 digits, decimal).
+62	1	A space character (U+0020).
+63	10	*Counter B:* Register value (10 digits, decimal).

Maxim DS2760/DS2761/DS2762

```
[DS2760 ] 30-000012B5735B-F4 2014-02-01 01:11:28 1680 +022.5 C 7BE0 +4.84 V FFF8
-0001 FFF4 -00012 00 +000 1
```

The gray text is the common part of the line of sense data.

Identification		DS2760
Offset	**Length**	**Description**
+52	4	*Temperature:* Register value (4 digits, hexadecimal).
+56	1	*Temperature:* A space character (U+0020).
+57	1	*Temperature:* Plus sign (U+002B) or minus sign (U+002D).
+58	3	*Temperature:* Mantissa (3 digits, decimal).
+61	1	*Temperature:* Decimal point (U+002E).
+62	1	*Temperature:* Fraction (1 digit, decimal).
+63	1	*Temperature:* A space character (U+0020).
+64	1	*Temperature:* ▪ 'C' for Celsius (U+0043). ▪ 'F' for Fahrenheit (U+0046). ▪ 'K' for Kelvin (U+004B).
+65	1	A space character (U+0020).
+66	4	*Voltage:* Register value (4 digits, hexadecimal).
+70	1	*Voltage:* A space character (U+0020).
+71	1	*Voltage:* Plus sign (U+002B) or minus sign (U+002D).
+72	1	*Voltage:* Mantissa (2 digits, decimal).
+73	1	*Voltage:* Decimal point (U+002E).
+74	2	*Voltage:* Fraction (2 digits, decimal).
+76	1	*Voltage:* A space character (U+0020).
+77	1	*Voltage:* 'V' for Voltage (U+0043).
+78	1	A space character (U+0020).

+79	4	*Current:* Register value (4 digits, hexadecimal).
+83	1	*Current:* A space character (U+0020).
+84	1	*Current:* Plus sign (U+002B) or minus sign (U+002D).
+85	4	*Current:* Mantissa (4 digits, decimal).
+89	1	A space character (U+0020).
+90	4	*Current accumulator:* Register value (4 digits, hexadecimal).
+94	1	*Current accumulator:* A space character (U+0020).
+95	1	*Current accumulator:* Plus sign (U+002B) or minus sign (U+002D).
+96	5	*Current accumulator:* Mantissa (5 digits, decimal).
+101	1	A space character (U+0020).
+102	2	*Current offset*: Register value (2 digits, hexadecimal).
+104	1	*Current offset*: A space character (U+0020).
+105	1	*Current offset*: Plus sign (U+002B) or minus sign (U+002D).
+106	3	*Current offset*: Mantissa (3 digits, decimal).
+109	1	A space character (U+0020).
+110	1	*PIO sensed state:* 0 or 1 (binary digit).

Program Exit Status

If the program executed successfully, it returns zero, else it returns -1.

Example Invocations of the Program

```
# ./owsrds -bscdetect abiowire -topo mynetworks.txt
```

This command reads topology file **mynetworks.txt** and tries to discover the containing networks on the AbioWire.

```
# ./owsrds -lu -network 28-40CCF80 26-16B4948 -network 28-3F4B4E9 -nid 2
```

This command defines two networks without any identification chips. The networks are to be discovered on all available USB-to-1-Wire adapters.

15 Topology Files

Overview

A topology file describes a number of 1-Wire networks in a human-readable text format. It's called a topology file because the file describes the topology of 1-Wire networks which are hierarchical in nature.

Text Encoding

A topology file contains Unicode text. The so-called byte order mark at the start of the file determines the encoding of the Unicode text. The **ows** programs supports the following file encodings:

Byte Order Mark	File Encoding
`<none>`	UTF-8
`EFh BBh BFh`	UTF-8
`FFh FEh`	UTF-16 Little Endian
`FEh FFh`	UTF-16 Big Endian

Each operating system uses a preferred encoding. This is called the default encoding in the **ows** software. An **ows** program that write topology files will apply the following default encodings:

- Linux: UTF-8.
- Windows: UTF-16 Little Endian.

Manual Editing

You can open a topology file with a text editor and modify its contents. If you decide to go this way, be sure your text editor can cope with Unicode, byte-order marks and file encodings, else you may end up with a corrupted topology file.

There are several reasons why you would manually edit a topology file:

- If you created the topology file with a 1-Wire adapter with built-in identification chip and you want to use another 1-Wire adapter, you can delete the ROM code of the identification chip (typically has family code 81h).
- If your network incorporates an identification chip (typically has family code 01h) and you created the topology file with a 1-Wire adapter with built-in identification chip, then you probably have no use for adapter's identification chip and you can remove the ROM code.
- You made a slight modification to a network but don't want to go through a lengthy enumeration process again.
- You want to copy-paste networks between topology files, split a topology file, or merge several topology files into one file.
- You prefer to create your own file from scratch.

Usage

Here's a simple example on how to use topology files. This example assumes you're using an AbioWire with one or more 1-Wire networks connected.

```
# ./owsenum -bscdetect abiowire -hub -topo mynetworks.txt
```

This command enumerates the 1-Wire hub and slaves on all channels of all controllers of the AbioWire and creates a topology file called **mynetworks.txt**.

Once the topology file has been created, you can read the sensor devices with the following command:

```
# ./owsrds -bscdetect abiowire -topo mynetworks.txt
```

This command will first detect all networks in the topology file on the available channels of the AbioWire. For each detected network the program reads the known sensors devices as they're described in the topology file. If hubs and subbranches are part of the network, the program will activate and deactivate the necessary hub ports in order to reach the various sensor devices.

You can reconnect the networks to different channels on the AbioWire. You can even reconnect them to other 1-Wire adapters. The program always runs a detection procedure hence an explicit binding between a network and a 1-Wire channel doesn't exist.

If you change the topology of a specific network (add a sensor device, reconnect a subbranch to a different hub port, …) then you'll have to regenerate or manually edit the topology file to reflect the new situation on the network.

Contents

Let's get started with a topology file for an example network. The topology file is created by program **owsenum** in Linux:

```
# ./owsenum -lu -hub -topo home.txt utf8
```

Suppose the network is connected to a DS9490R USB-to-1-Wire adapter and its topology is as the enumeration program outputs:

```
01: USB to 1-Wire (libusb bus 001 ad 002)
  01: DS2490
    01: 28-0000040CF2DE-60  DS18B20 thermometer
    01: 01-000016707B77-0E  DS2401/2411/1990A silicon serial number
    01: 81-000000324BBD-31  DS1420 serial ID button
    01: EF-000015207600-03  Hobby Boards 4-Channel Hub
      01: EF-000015206836-82  Hobby Boards 4-Channel Hub
        02: 26-0000016B4948-00  DS2438 smart battery monitor
        03: 10-000802A49A17-B1  DS18S20/1920 thermometer
        03: 28-0000043F84D2-2C  DS18B20 thermometer
        04: 28-000003F4B4E9-6A  DS18B20 thermometer
        04: 28-0000040CF499-0C  DS18B20 thermometer
      02: 28-0000040CCF80-35  DS18B20 thermometer
      02: 22-0000003201DA-1C  DS1822 Econo digital thermometer
```

Let's take a closer look at this particular network:

- There are two hubs, one connected to a port of the other one. This connection scheme adds two levels to the device tree.
- The network feature its own identification chip (family code 01h). The chip is location in the top-level branch of the network.
- The identification chip with family code 81h is part of the DS9490R USB-to-1-Wire adapter.
- The other 1-Wire slaves are temperature sensors of various types.

The enumeration program creates topology file **home.txt** encoded as UTF-8. The file contains the following text:

```
# ows topology file
#
# Encoding: UTF-8
#
# Created: 2014/02/01 18:01:48

network
{
    "28-0000040CF2DE"  .
    "01-000016707B77"  .
    "81-000000324BBD"  .
    "EF-000015207600"  hbh4  .
    {
        port 1
        {
            "EF-000015206836"  hbh4  .
            {
                port 2
                {
                    "26-0000016B4948"  .
                }
                port 3
                {
                    "10-000802A49A17"  .
                    "28-0000043F84D2"  .
                }

                port 4
                {
                    "28-000003F4B4E9"  .
                    "28-0000040CF499"  .
                }
            }
        }

        port 2
        {
            "28-0000040CCF80"  .
            "22-0000003201DA"  .
        }
    }
}
```

The file name extension **.txt** isn't required. You can use any extension you want or none at all, the software doesn't look for any extension. The **.txt** extension is used in this document to denote the topology file contains text and can be edited with a text editor.

The topology file **home.txt** describes one network. Note that a topology file can describes any number of networks.

The **network** label starts the description of a network. The **{** character (U+007B) must follow. The **}** character (U+007D) indicates the end of the network description.

A 1-Wire slave device is defined as a formatted string between two **"** characters (U+0022). The string must contain the following elements in the given order:

1. The family code (00..FF, hexadecimal, case-insensitive, leading zeroes are optional).
2. A hyphen (minus) character (U+002D).
3. The serial number (12 digits, hexadecimal, case-insensitive, leading zeroes are optional).

Optional part:

4. A hyphen (minus) character (U+002D).

5. CRC value (00..FF, hexadecimal, case-insensitive, leading zeroes are optional).

If the optional CRC part is specified, the CRC value must be valid.

The string can be followed by one or more labels and must be concluded with a dot character (U+002E).

The **hbh4** label says the 1-Wire slave is a Hobby Boards 4-channel hub. After the dot character, the description of the hub is expected between a **{** character (U+007B) and a **}** character (U+007D). The label **port** starts the description of a subbranch of the network. The label is followed by the port number. After the port number the description is the same as with the **network** label.

The **ds2409** label indicates the 1-Wire slave is a DS2409 hub chip. If this label isn't specified, the program will ignore the DS2409 1-Wire slave. The syntax after the dot character is the same as with the **hbh4** label.

16 Serial Paths

You need to specify a serial path in order to communicate with a serial port. The next sections explain in more detail how you specify serial paths in each supported operating system.

Linux

Serial ports are accessible in the device directory structure. A serial path starts with **/dev**. A serial path is case-sensitive.

The following table summarizes serial paths that are commonly found on Linux systems:

Serial Path	Serial Port
/dev/ttyS0	The computer's 1st on-board serial port
/dev/ttyS1	The computer's 2nd on-board serial port
/dev/ttyS2	The computer's 3rd on-board serial port
/dev/ttyS3	The computer's 4th on-board serial port
/dev/ttyUSB0	1st USB serial adapter
/dev/ttyUSB1	2nd USB serial adapter
/dev/serial/by-id/	This directory contains symbolic links to serial devices. Each symbolic link name identifies a specific device.
/dev/serial/by-path/	This directory contains symbolic links to serial devices. Each symbolic link name represents a hardware path to the device, like a specific USB port on your computer.

Here are some useful commands you can run to get information about present serial devices and their corresponding serial path. The following commands were run on a Linux system with one on-board UART and one connected USB-to-serial adapter.

Filter information from the kernel message buffer:

```
$ dmesg | grep 'tty'
[    0.000000] console [tty0] enabled
[    0.516785] serial8250: ttyS0 at I/O 0x3f8 (irq = 4) is a 16550A
[    0.517463] 00:0b: ttyS0 at I/O 0x3f8 (irq = 4) is a 16550A
[    0.559097] tty tty55: hash matches
[   66.076326] usb 2-1: FTDI USB Serial Device converter now attached to ttyUSB0
```

Use the **setserial** command to produce a list of serial paths:

```
$ setserial -g /dev/ttyS* /dev/ttyUSB*
/dev/ttyS0, UART: 16550A, Port: 0x03f8, IRQ: 4
/dev/ttyS1, UART: unknown, Port: 0x02f8, IRQ: 3
/dev/ttyS2, UART: unknown, Port: 0x03e8, IRQ: 4
/dev/ttyS3, UART: unknown, Port: 0x02e8, IRQ: 3
/dev/ttyUSB0, UART: unknown, Port: 0x0000, IRQ: 0, Flags: low_latency
```

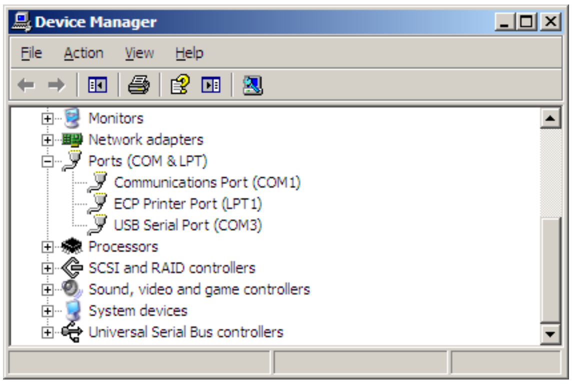
List serial devices in the device directory:

```
$ ls -l /dev/ttyS* /dev/ttyUSB*
crw-rw---- 1 root dialout   4, 64 2012-02-22 14:19 /dev/ttyS0
crw-rw---- 1 root dialout   4, 65 2012-02-22 14:19 /dev/ttyS1
crw-rw---- 1 root dialout   4, 66 2012-02-22 14:19 /dev/ttyS2
crw-rw---- 1 root dialout   4, 67 2012-02-22 14:19 /dev/ttyS3
crw-rw---- 1 root dialout 188,  0 2012-02-22 14:20 /dev/ttyUSB0
```

Windows

Serial ports are accessible through the Win32 device namespace, which is part of the NT namespace. As such a serial path starts with **\\.** followed by the device name of the serial port. A serial path is case-insensitive.

A serial port is typically named **COM<x>** where **<x>** is a number between 1 and 256. Other naming schemes may apply and aliases may exist, depending on the serial driver that controls the serial port.



You can obtain a list of available serial ports in the device manager. Open the device manager and view devices by type. The section named *Ports (COM & LPT)* contains all available serial and parallel ports.

The device name of a serial port is shown between parentheses. In the picture to the right, you can see two serial ports. COM1 is the PC's on-board serial port, COM3 represents a USB serial adapter.

The serial paths to the serial ports in the picture are:

Serial Path	Serial Port
\\.\COM1	*Communications Port (COM1)*
\\.\COM3	*USB Serial Port (COM3)*

Serial paths like **COM1** (that's without the **\\.** prefix) will work because COM1 to COM9 are reserved names in the NT namespace. COM10 to COM256 aren't reserved names and you'll have to specify the **\\.** prefix with these device names. By comparison, serial path **\\.\COM100** will work but serial path **COM100** won't work.

17 Troubleshooting

Error 4008 on BCM2835-based Computer

With certain combinations of the LibUSB library and the Linux kernel, LibUSB may generate error messages and fail USB transfers when the program is working with multiple USB-to-1-Wire adapters. In this case, you can specify **-mt 1** to (hopefully) solve the problem.

We found one source on the Internet that mentions this problem. The source indicates the problem can be solved by upgrading to version 3.2.27 or later of the Linux kernel:

```
http://www.raspberrypi.org/phpBB3/viewtopic.php?t=19393
```

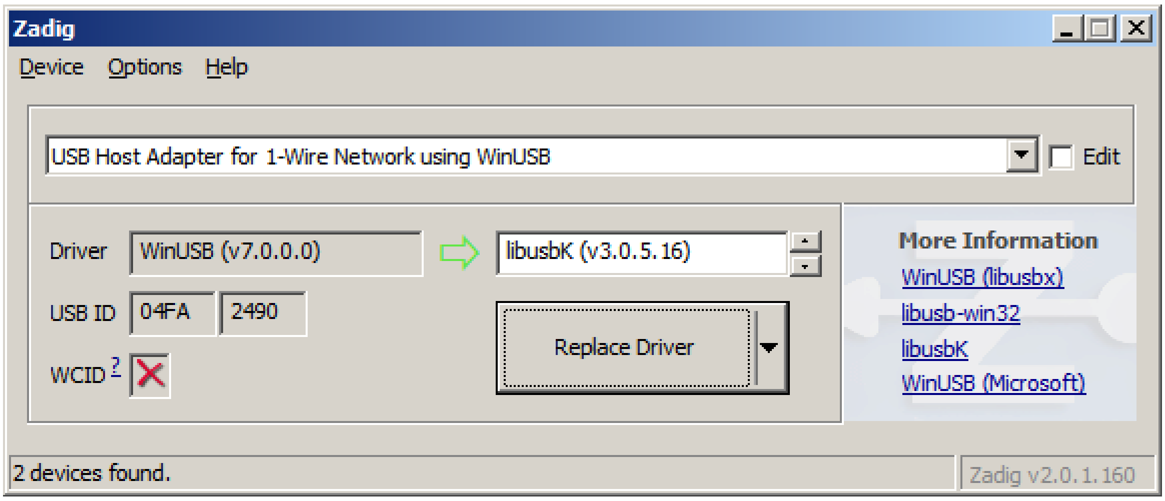
Please be aware this web link may become unavailable in time due to changes in the web site.

Program Fails Every Other Time

If you're using a DS9490 USB-to-1-Wire adapter on Windows, you may observe a situation where an **ows** program fails every other time you run it.

The reason of this failure is a timeout condition somewhere in LibUSB or a lower-level driver. For some reason one of the USB transfers scheduled by the program is accepted but not sent to the USB hardware, leading to the timeout condition.

We've noticed that you can circumvent this situation by upgrading from the WinUSB driver to the libusbK driver. The easiest way to upgrade the driver is using the **zadig** program from the libwdi project.



USB Host Adapter for 1-Wire Network using WinUSB ☐ Edit

Driver: WinUSB (v7.0.0.0) → libusbK (v3.0.5.16)

USB ID: 04FA 2490

WCID ?: ☒

2 devices found.

Zadig v2.0.1.160

In the Options menu, check **List All Devices**. Select your DS9490 USB-to-1-Wire adapter from the drop-down box. Select **libusbK** in the box right to the green arrow. Choose **Replace Driver** and click. The program will now upgrade the driver. If it asks you whether to replace newer files with older file you may choose **Yes** to do so (if you choose **No** you'll end up with a combination of files from different driver installations which may in turn lead to other problems).

LibUSB and TMEX are Fighting

When you run an **ows** program in Windows, there's nothing that prevents you from targeting a 1-Wire master twice. For example:

```
> owsenum.exe -lu -tm 6 1
```

Both LibUSB and TMEX will access the same USB-to-1-Wire adapter. By design, TMEX will get access to the USB device while LibUSB won't.

18 Software Design

This section discusses a number of attributes of the design of the **ows** software.

Threading

Each **ows** program is single-threaded in its proper context. This means it embodies single-threaded behavior to the extend of its own implementation. In-process libraries and the operating system aren't taken into account.

External libraries that are present in the program's process space may create threads for their own usage. This doesn't influence the single-threaded behavior of the **ows** programs.

To accomplish the aforementioned behavior, the **ows** software follows these rules:

- It is fully asynchronous by design.
- It employs a fine-grained control mechanism for blocking its main thread.

An important necessity is the availability of asynchronous (non-blocking) mechanisms in the operating system and external libraries.

LibUSB can be used non-blocking and single-threaded as long as a callback function invoked by LibUSB doesn't call back into LibUSB.

TMEX is completely synchronous, so it's not really compatible with the design of the **ows** software. To circumvent this restriction, the **ows** software creates a thread for each TMEX 1-Wire controller and delegates the execution of each 1-Wire bus transaction to this thread in a serialized, fully deterministic way. As a result, interfacing with TMEX is rather slow. As such it is advised to use TMEX only for 1-Wire adapters that aren't directly supported by the **ows** software.

Libraries

The **ows** software loads the following libraries dynamically and only when needed:

- LibUSB (Linux, Windows).
- TMEX (Windows).

This means the **ows** programs can run without these libraries. However if one of the libraries isn't installed you won't be able to use its specific functionality. Specify option **-v** to see how a program deals with missing libraries.

19 Software Revision History

Version	Description
1.0.0	▪ Initial release of ows.
1.1.0	▪ Fixed a hang-up while handling multiple 1-Wire channels (owsprobe, owrgbctrl, owswitch). ▪ Removed unwanted printing. ▪ Added program owhbh4.
1.2.0	▪ Added hierarchical enumeration throughout hubs (owsenum). ▪ Added enumeration of 1-Wire slaves with the alarm flag set (owsenum). ▪ Added enumeration of 1-Wire slaves of a certain family (owsenum). ▪ Fixed bug in setting of single-channel and multichannel mode (owhbh4). ▪ Added program owsrds. Supported sensor devices are DS18S20, DS1822, DS2438, DS18B20. ▪ Added the concept of the topology file (owsenum, owsrds).
1.2.1	▪ Fixed a crash when specifying option -lu in Windows 2000 (all programs). ▪ Added support for DS2423, DS2406, DS2408 (owsrds). ▪ Added representation of temperatures in Fahrenheit (owsrds). ▪ Added representation of temperatures in Kelvin (owsrds). ▪ All temperature values are rounded to the nearest tenths instead of being truncated (owsrds).
1.2.2	▪ Added support for DS2409 (owsenum, owsrds).
1.3.0	▪ Added program owsmlc. ▪ Added program owspio. ▪ Fixed help text produced by option -h (owsprobe, owswitch).
1.3.1	▪ Added m.nu 1-Wire adapter. ▪ Added support for DS2760, DS2761, DS2762 (owspio, owsrds).
1.3.2	▪ Added reporting of VDD of DS2438 (owsrds). ▪ Add reporting of RSTZ pin configuration and power mode of DS2408 (owsrds). ▪ Fixed a non-deterministic hang situation with LibUSB when the library was called into from a callback function. ▪ Updated the list of known 1-Wire devices and family codes.

20 Software License

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